STRATEGY RESEARCH PROJECT



# AN ASSESSMENT OF MODELING AND SIMULATION TOOLS FOR FORCE PROJECTION

BY

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## ABSTRACT

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The Army Chief of Staff, General Shinseki, has accelerated the transformation of strategic mobility by establishing new benchmarks for force projection – one brigade anywhere in the world within 96 hours, one division within 120 hours and five divisions within 30 days. The challenge is to deliver, throughput and control deploying forces into and within a theater using improved or austere seaports, airfields, facilities and lines of communication.

Lessons learned from Operation Desert Storm and subsequent small scale contingencies resulted in the development and refinement of joint doctrine for mobilization, deployment/redeployment, airlift, sealift, movement control, water terminals, joint logistics-over-the-shore (JLOTS), use of inter-modal containers and joint reception-staging-onward movement-integration (JRSOI). The Defense community complemented this progress by developing a series of modeling and simulation (M&S) tools to enhance force projection planning and execution. In spite of ongoing initiatives, the Department of Defense continues to experience difficulty in defining and prioritizing force projection requirements and capabilities due to a lack of authoritative end-to-end analysis. The time is right and M&S technology is available to resolve these issues.

This study surveys M&S applications and management; summarizes current system capabilities; and proposes changes to improve the quality, depth and scope of force projection planning.

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# AN ASSESSMENT OF MODELING AND SIMULATION TOOLS FOR FORCE PROJECTION

*"Doctrine must be written, taught and practiced."*

Professor Michael J. Morin
U.S. Army War College

Force projection is clearly one of the foundations of our employment of the military element of U.S. national power. The objective is to deliver, rapidly throughput and control deploying forces into and within a theater using improved or austere seaports, airfields, facilities and lines of communication.[1] The key institutional players in executing force projection operations are the U.S. Transportation Command (USTRANSCOM), its three components, Military Traffic Management Command (MTMC), Military Sealift Command (MSC), and Air Mobility Command (AMC), and U.S. Joint Forces Command (USJFCOM), U.S. Army Forces Command (FORSCOM) and power projection installations.

Lessons learned from Operation Desert Storm and subsequent small scale contingencies resulted in the development, refinement and publication of joint doctrine for mobilization, deployment and redeployment, airlift, sealift, movement control, water terminals, joint logistics-over-the-shore (JLOTS), use of inter-modal containers, and joint reception-staging-onward movement-integration (JRSOI). The Defense community has complemented this progress with the development and/or refinement of a series of modeling and simulation (M&S) tools to enhance force projection planning and execution.

Although force projection execution systems and processes are documented, taught and frequently practiced, the systems for planning and predicting requirements, capabilities and risks require changes in focus and efficiency. While ongoing initiatives clearly reflect significant technical advances, the Department of Defense (DoD) (particularly, the Army) continues to experience difficulty in defining, articulating and prioritizing force projection requirements and capabilities due to a lack of authoritative end-to-end analysis. Further complicating this matter, with few exceptions, war planners in combatant commands lack organic planning tools required to quickly and accurately determine strategic mobility requirements and capabilities.

The Army Chief of Staff, General Shinseki, has inspired innovative thinking and accelerated the transformation of strategic mobility by establishing new benchmarks for force projection – one brigade anywhere in the world within 96 hours, one division within 120 hours and five divisions within 30 days.[2] The time is right and M&S technology can significantly contribute to this transformation.

This paper surveys M&S applications and management; summarizes current system capabilities; and proposes systemic changes to improve the quality, depth and scope of force projection planning. The driving issues are captured in the following questions:

- Why and how are M&S tools applied to force projection operations?
- Who are the key players?

- What sectors of the force projection spectrum do current models address?
- Do current models omit or inadequately address any critical tasks, aspects or functions in the force projection spectrum?
- Are current M&S management processes effective and efficient?
- Is there an authoritative model or set of models available for force projection planning, training and exercises?

## M&S APPLICATIONS IN FORCE PROJECTION

The warfighting community has historically used M&S technology to examine the utility of concepts, ideas, capabilities or doctrine given a range of alternative futures; explore the best ways to employ platforms and forces we intend to acquire in realistic future scenarios; test the adequacy of current or planned forces in projected or official scenarios; and to familiarize key players with force or service component capabilities. [3] In force projection M&S tools currently support three functions -- transportation feasibility analysis, programmatic support and wargaming.[4] Feasibility analysis addresses time phased force deployment data (TPFDD) validation, transportation mode availability and capabilities, port and transportation infrastructure suitability, cargo throughput assessments and realistic scheduling. Programmatic output provides justification for planning, programming and budget system (PPBS) decisions and wargaming applications support scenario-driven battle staff training and institutional education.

The products generated by force projection M&S tools affect command decisions at every level from the National Command Authorities (NCA) to Joint Task Force (JTF) commanders. Analysis of requirements, capabilities, and associated risks contribute to course of action (COA) development and directly influence Service PPBS priorities and Congressional appropriations. Therefore, accuracy, credibility and accountability are absolutely critical. Several key players and institutions use, develop and manage force projection M&S capabilities. Who are they and how are they connected?

## KEY PLAYERS

### *USERS AND CUSTOMERS*

The Chairman of the Joint Chiefs of Staff (CJCS) advises the Secretary of Defense (as well as the President and National Security Council) on critical deficiencies and strengths in logistics and mobility capabilities; provides impact assessments with regard to national security objectives and strategic plans; and reviews combatant command plans and programs to determine adequacy, consistency, acceptability and feasibility.[5] The Vice Director, Joint Staff, is the Senior Information Resources Management Official (SIRMO) and the Director, J8, orchestrates joint M&S Master Plan processes.[6]

One of four functional and all five geographic combatant commands play significant roles in force projection planning and execution. USTRANSCOM provides air/land/sea transportation, common-user port management and deployment feasibility estimates for deliberate and crisis planning.[7] One of its subordinate elements, the Joint Intelligence Center for Transportation (JICTRANS), is a repository for information on worldwide infrastructure capabilities (airfields, seaports, rail, road, and inland waterways).[8]

USTRANSCOM also exercises combatant command authority (COCOM) over the AMC, MSC and MTMC. Serving as the component command for common-user air transportation, AMC provides aerial deployment and redeployment of forces, logistical resupply, aero-medical evacuation, Presidential airlift and aerial refueling.[9] MSC is the component command for common-user waterborne transportation and manages the expansion and employment of strategic sealift.[10] MTMC coordinates and provides ground freight and passenger movements; manages common-user ocean ports on a worldwide basis; and provides scientific, engineering and transportation analysis for deployability improvements.[11]

As one of five geographic combatant commands, United States Joint Forces Command (USJFCOM) is the joint force provider; integrates Service, Reserve Component and interagency capabilities; leads joint experimentation; and provides JTF staff training through simulation-driven command post exercises.[12] The remaining geographic combatant commands (Central Command, European Command, Pacific Command and Southern Command) build, validate and submit movement requirements to USTRANSCOM; regulate transportation flow; request reception, staging, onward movement and integration (RSOI) support;[13] and ensure that force projection planners are trained, exercised and formally assessed on their abilities to determine requirements and coordinate support.[14]

***OVERSIGHT AND COORDINATION***

A broad array of Defense and Service agencies, offices and centers manage M&S systems and provide technical direction. The Defense Modeling and Simulation Office (DMSO) is DoD's lead organization responsible for maximizing M&S efficiencies, effectiveness and interoperability.[15] The Defense Advanced Research Projects Agency (DARPA) directs high-risk research and development (R&D) projects with technologies that have high-payoff potential.[16] The Joint Logistics Technology Office (JLTO) supports DARPA through management of logistics information technology initiatives related to force deployment and logistics planning, execution and tracking.[17] The MTMC Transportation Engineering Agency (TEA) provides transportability engineering solutions; develops modeling and simulation tools for end-to-end force projection analysis; assesses CONUS and host nation strategic mobility infrastructure capabilities; determines the deployment impact of changes in force modernization, design and structure; ensures that transportability considerations are integrated in DoD's acquisition process; and manages authoritative transportation data in support of deployment requirements.[18]

Reflective of its role as a significant stakeholder in force projection initiatives and developments, the Army provides extensive input through several organizations. The Army Modeling and Simulation Office (AMSO) provides M&S proponency, education advocacy, policy coordination and integration oversight.[19] The Center for Army Analysis (CAA) conducts force projection studies; evaluates Army capabilities to mobilize, deploy, employ and sustain joint and combined forces; develops and maintains analytical models and scenarios; develops methodologies for optimizing resources; and provides analytical support for Total Army Analysis (TAA).[20] The Army Transportation Center's Deployment Process Modernization Office (DPMO) provides subject matter expertise in force projection operations; contributes to doctrine developments; and ensures integration of future concepts with training, leader development, force structure and information systems.[21] One of DPMO's subordinate elements, the Force Projection Capabilities Office (FPCO), supports experimentation and development of modeling and simulation tools for end-to-end analysis.[22] The Force Projection Simulation Center supports the Force Projection Battle Lab Support Element (FPBLSE) with M&S technology and serves as the conduit for coordinating with other Defense agencies.[23] And last but not least, the Early Entry Lethality and Survivability (EELS) Battle Lab addresses force projection planning, preparation and execution with a focus on initial and follow-on force deployability, capabilities, survivability and sustainability.[24]

***EDUCATION AND TRAINING***

USJFCOM J7 (Director for Joint Training) provides staff leadership for joint force training and exercises; allocates resources; assesses the readiness of assigned forces form a joint/combined perspective; supervises joint doctrine reviews; and manages joint universal lessons learned.[25] USJFCOM's Joint Warfighting Center (JWFC) provides joint and multinational training support on a worldwide basis; manages and integrates models and simulations; and contributes to the development of joint doctrine and training.[26] USTRANSCOM's Joint Deployment Training Center (JDTC) is the learning and information resource node for doctrine, education and training; develops curriculum; and maximizes distance-learning technology.[27] In its role as a center of excellence for force projection, the Army Transportation Center collaborates with other Army elements, Services and USTRANSCOM in developing force projection doctrine, training and processes.[28] And, in an effort to educate senior leaders and joint staff officers, each of the Senior Service Colleges and the Armed Forces Staff College conducts scenario-driven crisis action exercises which include the integration and analysis of simulated force projection operations.

## FORCE PROJECTION M&S TOOLS AND CAPABILITIES

Credible force projection M&S systems should provide comprehensive end-to-end analysis from origin to tactical assembly areas in theater. Modeling capabilities should include force deployment and sustainment simulations with TPFDD detail, discrete RSOI events, multi-modal requirements determination and capability assessments, nodal assessments, optimization tools, application of changing threat conditions, consideration of constraints (geographic, resources, and political) and throughput analysis (including JLOTS operations).[29]

My research included a review of the characteristics and capabilities of force projection M&S tools. This effort yielded a total of 22 individual force projection models, three model confederations, 12 command proponents and 18 different technical developers. Figure 1 is a list of individual models, sponsors and technical developers. Figure 2 is a graphic depiction of model applications in each sector of the force projection spectrum. These tools vary widely in scope, focus, strengths and limitations. The following is a summary of individual model characteristics and capabilities in eight functional categories.

### *FORT TO PORT OF EMBARKATION (POE)*

The Strategic Transportation Analysis Unit Flow Model (**STAFLO**) is a route network analysis tool that provides force closure estimates at CONUS ports of embarkation.[30] It assesses the impact of integrating defense deployment activities with commercial and public traffic. The FORSCOM Flow Model (**FORCEFLO**) simulates the movement of deploying forces from mobilization stations and installations to POEs in CONUS.[31] It also provides closure trends, convoy routing schemes and TPFDD comparisons to determine conflicts.[32]

### *FORT TO POE AND PORT OF DEBARKATION (POD) TO TACTICAL ASSEMBLY AREA (TAA)*

Two models address critical infrastructure and RSOI capabilities in both CONUS and theater sectors of the force projection spectrum. The Enhanced Logistics Intra-theater Support Tool (**ELIST**) provides the capability to evaluate the feasibility of CONUS and theater surface transportation movement plans.[33] It applies infrastructure constraints (port capabilities, storage facilities, staging areas, road networks and rail offload) and factors-in the availability/arrival of lift assets and RSOI enabling units in the TPFDD. ELIST simulates the marry-up of unit equipment and troops in staging areas; accounts for host nation support; estimates closure trends; and allows users to pause, make realistic changes in infrastructure and lift capabilities, and continue the simulation. Reports generated include nodal analysis, routes, asset usage, movement constraints, commodity closure and arrival analysis.

| *Model* | *Proponent* | *Technical Developer* |
|---|---|---|
| Strategic Transportation Analysis Unit Flow Model (STAFLO) | MTMC TEA | University of Tennessee Transportation Center |
| FORSCOM Flow Model (FORCEFLO) | FORSCOM | Computer Sciences Corporation (CSC) |
| Enhanced Logistics Intra-theater Support Tool (ELIST) | MTMC-TEA/Joint Staff J8 | Argonne National Laboratory (ANL) |
| Transportation System Capability (TRANSCAP) | MTMCTEA | Argonne National Laboratory (ANL) |
| Integrated Computerized Deployment System (ICODES) | MTMC | California Polytechnical State University |
| Port Simulation Model (PORTSIM) | MTMC TEA | Argonne National Laboratory (ANL) |
| Joint Over the Shore Transportation Estimator (JOTE) | Logistics Management Institute (LMI) | Logistics Management Institute (LMI) |
| Joint Flow and Analysis System for Transportation (JFAST) | USTRANSCOM | Oak Ridge National Laboratory |
| Model for Inter-theater Deployment by Air and Sea (MIDAS) | Office of the Secretary of Defense (OSD)/Programs, Analysis and Evaluation (PA&E) and Joint Staff J4 | General Research Corporation (GRC) |
| Mobility Analysis Support System (MASS) | AMC | AMC |
| SMARTBRIDGE | U.S. Army Engineer School | Corps of Engineers Waterways Experiment Station |
| Mapping Analysis Tool for Transportation (MATT) | USTRANSCOM J5 | Bolt, Beranek and Newman, Inc (BBN) |
| Coastal Integrated Throughput Model (CITM) | MTMCTEA | US Army Engineer Research and Development Center (ERDC) |
| Force Analysis Simulation of Theater Administrative and Logistics Support (FASTALS) | CAA | CAA |
| Transportability Analysis Reports Generator (TARGET) | MTMC | MTMC TEA |
| TPFDD Editing and Analysis Capability (TPEDIT) | MTMC TEA | Bolt, Beranek and Newman, Inc (BBN) |
| Logistics Plan Generator (LOGGEN) | DARPA | MITRE |
| Analysis of Mobility Platform (AMP) | USTRANSCOM and DARPA | Bolt, Beranek and Newman, Inc (BBN) |
| Force Projection Modeling (FPM) | MTMC TEA | Argonne National Laboratory (ANL) |
| Global Deployment Analysis System (GDAS) | CAA | Noetics, Inc |
| Joint Educational Mobility Model (JEMM) | Air Force Wargaming Institute | Air Force Wargaming Institute |
| Crisis Action Model (CAM) | U.S. Army War College | U.S. Army War College |

**TABLE 1** - FORCE PROJECTION MODELS, PROPONENTS AND TECHNICAL DEVELOPERS

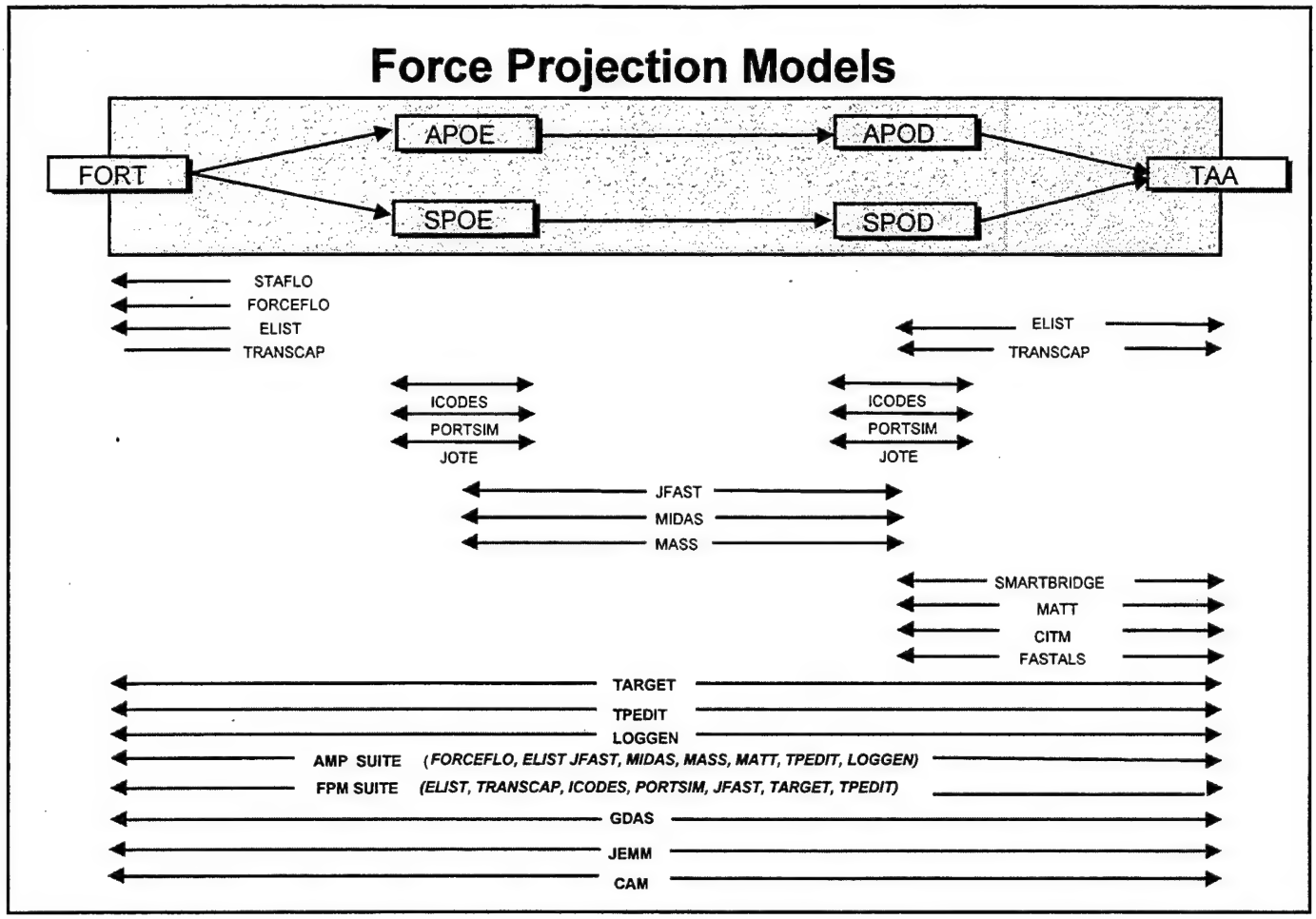


**FIGURE 1** - MODEL APPLICATIONS IN THE FORCE PROJECTION SPECTRUM

The Transportation System Capability (**TRANSCAP**) is an out-loading analysis tool that compares requirements and capabilities at the line item number (LIN) level of detail. It calculates installation and depot out-loading capabilities for all transportation modes (air, rail, truck and containers) over time; determines reception capabilities in theater staging bases and tactical assembly areas; and recommends courses of action to eliminate transportation system deficiencies when requirements exceed capabilities.[34]

***PORT OPERATIONS***

The following nodal M&S tools provide critical input for throughput analysis. The Integrated Computerized Deployment System (**ICODES**) is a ship stow planning system that uses artificial intelligence technology.[35] This model supports shipload planning at CONUS and OCONUS ports of

embarkation. The Port Simulation Model (**PORTSIM**) provides discrete event simulation of port operations. It applies constraints; determines port reception, staging, cargo clearance and throughput capabilities; and produces port clearance profiles for deploying units.[36] The Joint Over the Shore Transportation Estimator (**JOTE**) simulates in-stream discharge of strategic sealift ships.[37] While replicating landing craft, modular causeway systems and cargo lanes, it also considers equipment availability, operational readiness and sea state conditions in JLOTS ship to shore operations. However, it does not address utility watercraft requirements (tugboats, floating cranes and barges).

***POE TO POD***

Three models address strategic airlift and sealift, but differ significantly in capabilities. The Joint Flow and Analysis System for Transportation (**JFAST**) provides gross TPFDD feasibility estimates for course of action (COA) development and simulates movement of cargo and passengers from air/sea ports of embarkation to air/sea ports of debarkation.[38] Although it is not integrated into the Analysis of Mobility Platform (AMP) suite, it provides an interface for sharing and running results.[39]

The Model for Inter-theater Deployment by Air and Sea (**MIDAS**) is a strategic deployment scheduling tool that analyzes airlift, sealift, pre-positioned resources and logistical resupply. It also simulates movement of cargo and passengers from air/sea ports of embarkation to air/sea ports of debarkation.[40] MIDAS is an agile capability that responds to dynamic changes in lift requirements and capabilities; generates re-supply requirements for arriving forces; assesses the adequacy of planned lift assets and cargo handling equipment; selects the best mode for specific cargo; and models JLOTS operations.[41]

The Mobility Analysis Support System (**MASS**) is the authoritative Air Force standard for simulating fixed wing strategic and theater airlift operations.[42] The fidelity provided by MASS is unmatched by any single or collective system of airlift analysis products. It simulates military and commercial assets in strategic and theater operations; models airborne refueling; imposes aircrew and flying hour constraints; and replicates handling factors (ground times, maintenance and cargo payloads).[43]

***POD TO TAA***

**SMARTBRIDGE** is a theater infrastructure assessment tool that determines the military classification of OCONUS bridges.[44] Data sources include remote sensors as well as technical correlations and inferences. The Mapping Analysis Tool for Transportation (MATT) is a powerful enabler that integrates transportation data from several major systems already used by the Army, Navy and Air Force.[45] It provides interactive mapping and graphic displays that represent transportation infrastructure, facilities, networks, terrain features, port capabilities and activities, routing, bottlenecks and chokepoints.

The Coastal Integrated Throughput Model (**CITM**) is an analysis tool that recently filled a critical void in theater modeling. It allows planners to realistically evaluate JLOTS alternatives and helps the R&D community assess the utility of emerging technologies such as the Rapidly Installed Breakwater System (RIBS) and the Joint Modular Lighterage System (JMLS). CITM augments PORTSIM and ELIST and applies sea-based and inland environmental constraints to include sea state, wind, waves, bathymetry, tides, currents, road conditions, terrain, bare beach soil bearing capacities, rainfall and streams.[46] The Force Analysis Simulation of Theater Administrative and Logistics Support (**FASTALS**) is a planning tool that determines theater support force structure based on administrative and logistical workloads for deployments and tactical operations.[47] It generates requirements for geographically distributed maintenance, construction, supply, transportation, medical, and personnel units.

***FUNCTIONAL (FULL SPECTRUM)***

The Transportability Analysis Reports Generator (**TARGET**) provides Army unit movement data and estimates transportation lift requirements. It merges unit equipment authorizations from Modified Table of Organization and Equipment (MTOE) files with equipment characteristics from standard Equipment Characteristics File (ECF) and produces a unit equipment file (EUF).[48] It generates requirements for air sorties and surface movements (highway and rail); identifies equipment eligible for secondary loads on organic cargo vehicles; determines which equipment can be loaded in standard containers; models air, surface and container loading; and analyzes the impact of movement alternatives.[49] The TPFDD Editing and Analysis Capability (**TPEDIT**) allows planners to assess feasibility and it expands the TPFDD to LIN detail.[50] The Logistics Plan Generator (**LOGGEN**) combines TPFDD information with logistics planning factors and generates sustainment cargo requirements for deployment planning in class of supply and stock number detail.[51]

***SUITES (FULL SPECTRUM)***

The Analysis of Mobility Platform (**AMP**) is a confederation of models that allow users to tailor the integration of ELIST, FORCEFLO, JFAST, MASS, MIDAS, MATT, TPEDIT and LOGGEN.[52] It's an end-to-end analysis tool that provides gross force generation and logistics flow analysis (down to stock number detail). Functionally divided into three parts, the initial input includes TPFDD data, followed by review and modification of air and sea transportation plans. After setup, users run the sequence of individual models followed by review and analysis of the requirements, asset use, port use and deliveries.

Force Projection Modeling (**FPM**) is a suite that integrates the capabilities of TARGET, TPEDIT, TRANSCAP, ELIST, JFAST, PORTSIM and ICODES.[53] It is an end-to-end analysis tool that evaluates the interaction of infrastructure and transport systems with detailed transportability characteristics of the

deploying force. It simulates movement from installations to ports of embarkation, strategic lift and movements from ports of debarkation to tactical assembly areas (with LIN level of detail).

The Global Deployment Analysis System (**GDAS**) simulates comprehensive end-to-end deployment of troops, equipment and supplies from origins to theater tactical assembly areas.[54] It selects and distributes cargo on road, rail, air, sea, pipeline and inland waterways transportation modes; optimizes asset scheduling; and selects routes.[55] GDAS applies vehicle and cargo constraints by node/facility; accounts for marry-up of troops and equipment in assembly areas; determines requirements; and provides capability assessments.[56]

***EDUCATIONAL (FULL SPECTRUM)***

The Joint Educational Mobility Model (**JEMM**) is a wargaming decision support tool that simulates strategic airlift and sealift (for deployment and redeployment operations). It uses Joint Operation Planning and Execution System (JOPES) reference files for port and airfield data; provides high-level analysis for educational requirements; and allows custom tailoring to meet scenario requirements and training objectives.[57] JEMM is currently used as the force projection module in the Joint Land, Aerospace and Sea Simulation (JLASS) exercise. The Crisis Action Model (CAM) is an in-house U.S. Army War College educational M&S tool designed to highlight force projection issues and constraints that influence COA development in campaign planning.

**FUNCTIONAL REVIEW**

The main objective is to close gap between realism and simulations. Collectively, current M&S tools address critical tasks, functions and constraints in every sector of the force projection spectrum. These include:

- Rail movements (Fort to Sea Port of Embarkation (SPOE); SPOE to TAA)
- Highway/road movements (Fort to Air Port of Embarkation (APOE)/SPOE; Air Port of Debarkation (APOD)/Sea Port of Debarkation (SPOD) to TAA)
- Strategic airlift (APOE to APOD)
- Intra-theater airlift (APOD to TAA)
- Strategic sealift (SPOE to SPOD)
- In-stream ship discharge and ship to shore operations (JLOTS)
- Movement of sustainment cargo on intra-coastal main supply routes (MSR)
- Movement of sustainment cargo on inland waterway MSRs
- RSOI

Current M&S tools also provide analysis and feedback on:

- RSOI enabler availability, productivity and deficiencies (cargo handling units, ground and maritime transportation units and host nation support)
- Theater infrastructure capabilities, performance, and bottlenecks (air and sea ports, storage facilities, staging areas, marshalling areas, highway networks and rail networks)
- CONUS installation and depot out-loading capabilities and performance
- Worldwide military classification of bridges
- Coastal and inland waterway constraints (sea state, wind, waves, bathymetry, tides, currents, road conditions, terrain, bare beach soil bearing capacities, rainfall and streams)
- TPFDD force flow constraints and feasibility
- Closure estimates and status (unit equipment, troops and sustainment cargo)
- Marry-up of troops and unit equipment in staging areas
- Ship stow planning and alternatives
- JLOTS augmentation in support of pier side discharge operations
- Port clearance and throughput
- Discrete loading activities (air, ship, watercraft, vehicle and containers)
- Multi-modal selection and optimization
- Containerized cargo selection and optimization
- Equipment and cargo transshipment
- Logistics demands generated by deployed units
- Logistics and administrative force structure requirements
- Interactive transportation mapping

**EFFICIENCY REVIEW**

Currently, there is no authoritative model or set of models available to accurately and comprehensively address end-to-end requirements, capabilities and risks. Unfortunately, the fragmented internal and external efforts of 12 proponents and 18 technical producers resulted in functional overlap and duplication, limited interoperability, questionable accuracy and reduced cost effectiveness.

Notwithstanding, each of the three suites -- AMP, FPM and GDAS -- provides valuable functions and capabilities to facilitate developmental focus and synergy. All three have common strategic lift assessment capabilities, but each has unique end-to-end strengths and limitations. Common capabilities resident in both AMP and FPM are functions provided by ELIST, JFAST, MIDAS, and TPEDIT. GDAS is a stand-alone suite with capabilities similar to AMP and FPM. Although CITM, SMARTBRIDGE and JOTE are not imbedded in any of the suites, their functional capabilities are unmatched in quality and depth. Although JEMM and CAM were specifically designed to provide high-level aggregate output to

meet educational objectives, they serve as excellent prototypes for the expanded capabilities of objective M&S systems.

## THE ROAD AHEAD

DoD has recognized that rapid technological advances must be complemented by coherent strategies for direction, control and oversight of M&S programs. In an effort to comprehensively address analytical, programmatic, logistics and transportation requirements, elements within the DoD have initiated four major programs – the Joint Simulation System (JSIMS), the Joint Warfare System (JWARS), the Advanced Logistics Program (ALP) and the Transportation Analysis Modeling and Simulation (TAMS) Functional Process Improvement (FPI).

Currently under development, JSIMS is envisioned as a joint, combined and Service battle-space training tool that will simulate forces in every theater (with global connectivity) and provide mission planning and rehearsal capabilities.[58] This umbrella capability will provide the platform to unify strategic, operational and tactical training environments.[59] JWARS is an emerging planning and programming analysis tool (also under development) used to conduct operational and modernization assessments in support of investment decisions.[60] It will evaluate system-on-system effectiveness (friendly versus adversaries) at mission, battle or theater/campaign levels.[61]

ALPS is an initiative to transform transportation and logistics planning and execution. Objectives include elimination of isolated, independent and incompatible systems and development of collaborative systems that are responsive, flexible and precise.[62] TAMS FPI is a USTRANSCOM-sponsored initiative to evaluate and leverage M&S tools for end-to-end analysis and determine functional transportation requirements for JSIMS and JWARS.[63] Key objectives include reduction of redundant functions; development of a common or singular system for planning and execution; and development of an integrated capability for transportation feasibility analysis, programmatic analysis and wargaming.[64] In an effort to enhance realism, TAMS FPI intends to address the following considerations, capabilities and constraints in future M&S applications:

- Responsiveness to dynamic changes in exercise or real-world situations [65]
- Enemy employment of weapons of mass destruction (WMD) at critical transportation nodes (SPOD and APOD) [66]
- Overlapping and simultaneous operations in two major theaters of war (MTW) [67]
- Seamless transition from planning to execution [68]

## RECOMMENDATIONS

### *FORT TO POE*

Fort (or origin) to POE operations include surface movement of troops and selected equipment to departure airfields; delivery of heavy equipment by rail to sea ports; and movement of roadable equipment to sea ports by convoy. An overlooked capability is the use of Army watercraft in support of CONUS intra-coastal movement and shuttling of equipment between major ports to meet urgent requirements. Assets include Logistics Support Vessels (LSV), 2000 Series Landing Craft Utility (LCU) vessels, Landing Craft Mechanized (LCM-8), Large Tugboats and Small Tugboats. These assets and capabilities should be included in M&S applications because they provide valued-added strategic agility.

### *POD TO TAA (THEATER THROUGHPUT)*

Theater throughput (a potential strategic vulnerability) is affected by three elements in the transportation system – mode operations (highway, rail, air and water), terminal operations (air, land, sea and inland waterway) and movement control. ELIST, PORTSIM, CITM, JOTE, TRANSCAP, SMARTBRIDGE, MATT and FASTALS address mode and infrastructure issues. This includes consideration of constraints driven by the availability of lift assets, transportation networks, RSOI capabilities, host nation support, and JLOTS sea state conditions and cross-beach mobility. On the other hand, current models do not address the flow, availability and impact of port support activity (PSA) elements, movement control teams (MCT) or utility watercraft support. Also excluded are the availability and impact of employing cargo-carrying watercraft (LSVs, LCUs) to tactically displace combat units on water MSRs and consideration of maritime threats.

PSA elements consist of unit soldiers responsible for repairing, maintaining and driving wheeled and tracked vehicles off strategic sealift vessels in pier-side and in-stream discharge operations. PSA troops must be carefully managed in the TPFDD flow to ensure availability for ship arrival in theater. MCT elements facilitate port clearance by regulating the movement of all transportation assets during deployment, sustainment and redeployment operations to ensure network synchronization and optimization of delivery capabilities.

Utility watercraft (tugboats and floating cranes) support harbor, port and LOTS operations with towing, recovery, salvage, firefighting and in-stream heavy lift capabilities. After initial port-opening operations in theater, commercial tugboats and other harbor support assets will be contracted locally. The modeling issue is not the source of utility watercraft, but the quantities required for advance planning and execution.

Army LSVs (cargo capacity – 24 M1 Tanks) and 2000 Series Class LCUs (cargo capacity - 6 M1 tanks) provide tremendous operational and tactical agility in displacing combat power in coastal shore-to-shore and inland waterway (riverine) operations. When maneuver unit commanders begin to leverage this capability, requirements for Army watercraft will increase and planners must be prepared to assess tradeoffs between logistics support and dominant maneuver. In addition to considering the impact of enemy employment of WMD at APOD and SPOD nodes, M&S capabilities should also address the dynamics of harbor, coastal and inland waterway threats (surface, subsurface and air) in conjunction with Army, Navy and Coast Guard response capabilities.

***MODEL SELECTION PROCESS***

One of the major challenges is to reduce functional redundancy without sacrificing the unique capabilities resident in existing systems. However, systemic hurdles may hamper progress. In an effort to minimize costs and maximize usefulness and efficiency, the Joint Staff J-8 has already sanctioned the AMP suite, but did not include TRANSCAP, PORTSIM, ICODES, JOTE, SMARTBRIDGE, CITM or FASTALS on the list of authorized analytical tools.[69]

I strongly argue that force projection capabilities, tasks, events and constraints in the POD to TAA sector are the foundations of theater throughput. Ongoing shortfalls in the scope and depth of requirements determination, capability assessments and risk analysis in this sector are already strategic vulnerabilities. Therefore, we simply cannot afford to prematurely ignore opportunities to leverage the throughput assessment capabilities of models excluded by J-8 -- TRANSCAP, PORTSIM, ICODES, JOTE, SMARTBRIDGE, CITM, and FASTALS. At a minimum, there must be a commitment to identify and imbed the best of the best capabilities resident in current M&S tools. Contrary to J-8's position, TAMS FPI recommends continued development of the AMP suite plus PORTSIM, TARGET and TRANSCAP.[70]

***AUTHORITATIVE SOURCE***

To ensure efficiency and analytical consistency, the objective M&S package must serve as the single source for definitive answers. Essential functions include production of both detailed analysis (for deliberate planning and execution) and high level, gross estimates (for quick-turnaround analysis in crisis action planning and educational environments). Consistent with doctrine, this capability will give combatant commands a powerful set of organic tools to accurately determine and validate movement requirements; assess RSOI requirements, capabilities and shortfalls; and ensure that force projection planners are trained, exercised and formally evaluated.

### *LEADER DEVELOPMENT AND TRAINING*

Although force projection is clearly an immediate priority, current leader development and warfighter training systems do not provide the depth or continuity required to institutionalize thinking and planning at multiple levels below combatant commands. The aforementioned agility of objective M&S capabilities would significantly enhance education and training. Educational tailoring and quick turnaround analysis provide unprecedented avenues to include quality, interactive, realistic and consistent force projection training and exercises in Basic and Advanced Noncommissioned Officer Courses, the Sergeants Major Academy, Warrant Officer Basic and Advance Courses, Officer Basic and Advanced Courses, Command and General Staff Colleges, the Armed Forces Staff College, Senior Service Colleges and in the curriculums at officer training institutions (Service Academies, Reserve Officer Training Corps Programs and Officer Candidate Schools).

Capitalizing on current and emerging technology, web-based global access offers revolutionary opportunities. The combination of global connectivity, objective tailoring and quick turnaround analysis provides a unique venue to integrate the realistic impact of force projection requirements, capabilities and constraints in Corps and Division Battle Command Training Program (BCPT) Warfighter Exercises (WFX) and in Geographic Combatant Command Combined and Joint Force Command Post Exercises (CPX). Consistent with JSIMS objectives, this approach provides an M&S training environment that simultaneously accommodates strategic, operational and tactical levels of war. This connectivity also provides a means for key force projection supporting commands (FORSCOM, MTMC's Deployment Support Command, 143rd Transportation Command, 7th Transportation Group, power projection installations and others) to participate in CPX and WFX planning and execution through cost-effective remote access. In conjunction with M&S realism, this connectivity would foster unprecedented pre-crisis staff interaction and problem-solving; surface critical problems and issues in advance; and enable planners to assess the impact of recommendations and decisions.

## CONCLUSION

Strategic responsiveness is a high priority (especially in the Army) and the DoD force projection community is on the cutting edge of an extraordinary transformation in leveraging M&S technology. I am convinced that current and emerging force projection M&S capabilities will empower us to:

- Evaluate our concepts and doctrine
- Determine the adequacy of current and programmed forces and capabilities
- Explore and identify future requirements
- Justify budget priorities
- Assess risks (funding and operational)
- Imbed force projection thinking in our warfighting culture through leader development programs and educational institutions

- Institutionalize force projection planning as a critical core competency at strategic, operational and tactical levels
- Provide unprecedented global connectivity, interaction and problem solving among supported and supporting commands

Although several agencies, offices and centers manage and influence force projection M&S system developments, USTRANSCOM clearly plays the most pivotal role in affecting changes, providing focus, leveraging resources, and maintaining connectivity to JSIMS and JWARS (through TAMS FPI). The appropriate M&S tools and technology are available now. The challenges are to maintain momentum, focus and funding; ensure M&S realism by identifying and embedding the best of the best capabilities of current systems; enhance realism through continuous refinement; sustain integration with JSIMS and JWARS; and to produce an authoritative system of adaptive M&S capabilities.

Our force projection doctrine is clearly documented. Realistic, agile, authoritative and globally connected M&S capabilities will ensure that our doctrine is taught, practiced and relevant at strategic, operational and tactical levels of warfighting. The stakes are extremely high and the outputs will drive DoD warfighting assessments, Congressional funding priorities and NCA decisions.

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